Table 1 — Guidance for balance quality grades for rotors in a constant (rigid) state

Machinery types: General examples	Balance quality grade G	Magnitude $e_{per} \cdot \Omega$ mm/s
Crankshaft drives for large slow marine diesel engines (piston speed below 9 m/s), inherently unbalanced	G 4000	4 000
Crankshaft drives for large slow marine diesel engines (piston speed below 9 m/s), inherently balanced	G 1600	1 600
Crankshaft drives, inherently unbalanced, elastically mounted	G 630	630
Crankshaft drives, inherently unbalanced, rigidly mounted	G 250	250
Complete reciprocating engines for cars, trucks and locomotives	G 100	100
Cars: wheels, wheel rims, wheel sets, drive shafts Crankshaft drives, inherently balanced, elastically mounted	G 40	40
Agricultural machinery Crankshaft drives, inherently balanced, rigidly mounted Crushing machines Drive shafts (cardan shafts, propeller shafts)	G 16	16
Aircraft gas turbines Centrifuges (separators, decanters) Electric motors and generators (of at least 80 mm shaft height), of maximum rated speeds up to 950 r/min Electric motors of shaft heights smaller than 80 mm Fans Gears Machinery, general Machine-tools Paper machines Process plant machines Pumps Turbo-chargers Water turbines	G 6,3	6,3
Compressors Computer drives Electric motors and generators (of at least 80 mm shaft height), of maximum rated speeds above 950 r/min Gas turbines and steam turbines Machine-tool drives Textile machines	G 2,5	2,5
Audio and video drives Grinding machine drives	G 1	1
Gyroscopes Spindles and drives of high-precision systems	G 0,4	0,4

NOTE 1 Typically completely assembled rotors are classified here. Depending on the particular application, the next higher or lower grade may be used instead. For components, see Clause 9.

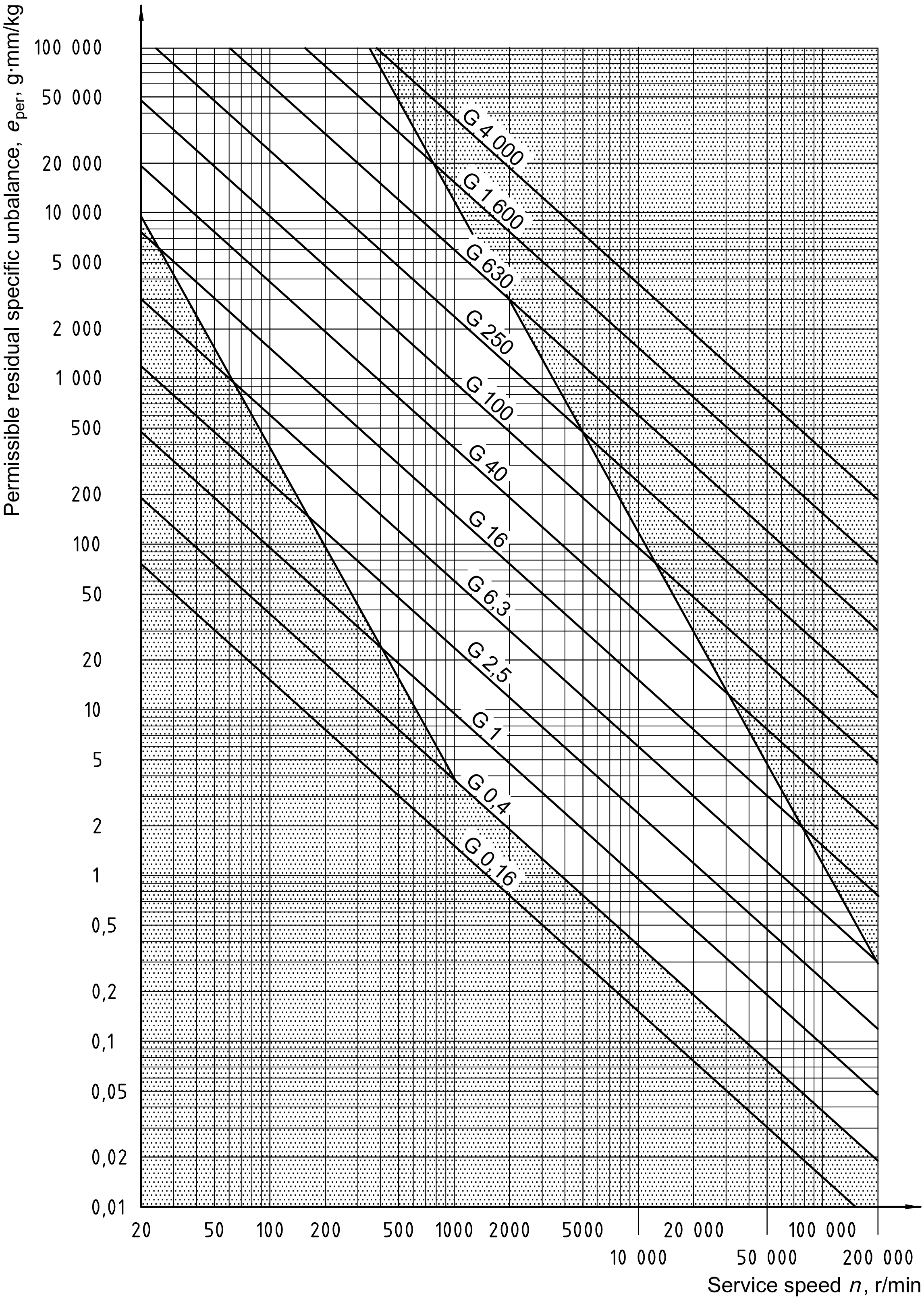
NOTE 2 All items are rotating if not otherwise mentioned (reciprocating) or self-evident (e.g. crankshaft drives).

NOTE 3 For limitations due to set-up conditions (balancing machine, tooling), see Notes 4 and 5 in 5.2.

NOTE 4 For some additional information on the chosen balance quality grade, see Figure 2. It contains generally used areas (service speed and balance quality grade G), based on common experience.

NOTE 5 Crankshaft drives may include crankshaft, flywheel, clutch, vibration damper, rotating portion of connecting rod. Inherently unbalanced crankshaft drives theoretically cannot be balanced; inherently balanced crankshaft drives theoretically can be balanced.

NOTE 6 For some machines, specific International Standards stating balance tolerances may exist (see Bibliography).



NOTE The white area is the generally used area, based on common experience.

Figure 2 — Permissible residual specific unbalance based on balance quality grade G and service speed ***n*** (see 6.2)

6.4 Methods based on special aims

6.4.1 Limited bearing forces

The main objective may be to limit the bearing forces caused by unbalances. The limits are stated first in terms of bearing forces, but then need transformation into unbalances. In the case of a sufficiently steady (not moving) bearing housing, this transformation simply uses the equation for the centrifugal force (see Annex B).

In all other cases, the dynamic behaviour of the structure under service condition shall be considered. There are no simple rules available for these cases.

6.4.2 Limited vibrations

The main objective in this case is to limit vibrations in certain planes. This may be of interest for instance for hand-held machines. Balance quality requirements can be derived from these limits (see Annex C).

6.5 Methods based on established experience

If a company has gained sufficient established experience to assess the balance quality of its products, it may make full use of this. Annex D gives some guidance.

7 Allocation of permissible residual unbalance to tolerance planes

7.1 Single plane

In the case of single-plane correction, U_{per} is used entirely for this plane (see 4.5.2). In all other cases, U_{per} shall be allocated to the two tolerance planes.

7.2 Two planes

7.2.1 General

The permissible residual unbalance U_{per} is allocated in proportion to the distances from the mass centre to the opposite tolerance plane (see Figures 3 and 4). If the tolerance planes are the bearing planes A and B, the following equations apply:

$$U_{\text{per A}} = \frac{U_{\text{per}} \cdot L_{\text{B}}}{L} \tag{8}$$

$$U_{\text{per B}} = \frac{U_{\text{per}} \cdot L_{\text{A}}}{L} \tag{9}$$

where

$U_{\text{per A}}$ is the permissible residual unbalance in bearing plane A;

$U_{\text{per B}}$ is the permissible residual unbalance in bearing plane B;

U_{per} is the (total) permissible residual unbalance (in the mass centre plane);

L_{A} is the distance from mass centre plane to bearing plane A;

L_{B} is the distance from mass centre plane to bearing plane B;

L is the bearing span.